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ABSTRACT

This special edition of the National Action Council for Minorities in Engineering (NACME) Research Letter focuses on the state of engineering and affirmative action. The argument is made that the underrepresentation of minority groups in engineering fields in the United States jeopardizes the nation's future competitiveness. The consequences of exclusion, declining enrollment in engineering, the growing demand for engineers, the assault on affirmative action, retention in engineering, precollege preparation, and the need for action are discussed in detail. (DDR)

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NACME

Engineering and Affirmative Action:
Crisis in the Making

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"The backlash against affirmative action, rapidly gaining momentum across the country, is shutting down further progress for America's fastest growing population groups, already notably absent from high-growth Information Age jobs."

Engineering and Affirmative Action: Crisis in the Making

George Campbell Jr., Ph.D.

A Special Edition of the *NACME Research Letter*

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Minorities in Engineering, Inc.
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Engineering and Affirmative Action: Crisis in the Making[1]

George Campbell Jr., Ph.D.

The persistent, conspicuous underrepresentation of groups that account for 33 percent of the birth rate jeopardizes the nation's future competitiveness and, consequently, the standard of living, not only for minorities, but for all Americans.

The Consequences of Exclusion

Seattle, the carefully selected venue for NACME's 1997 Forum, is surrounded by a magnificent array of natural wonders that stimulate the senses and inspire creativity — the majesty of Mount Ranier, the serenity of Lake Washington and Puget Sound, the rugged wilderness of the Cascade and Olympic Mountains. But we chose the "Emerald City" not for its enchanting beauty or seductive charm but because it anchors a vital sector of the country, one that's erupting with emerging technology, one that's immersed in issues critical to NACME's mission. No region is generating more innovation or spawning more advanced technology companies. The flourishing demand for engineers in the corridor between Seattle and Portland far outpaces the production of new graduates in the region and substantially exceeds the available supply of well-trained talent. At the same time, the representation of African Americans, Latinos and American Indians in the technical professions in the northwest lags behind other parts of the country, and the number of minority engineering graduates from area colleges is well below the national average.

In 1996, minorities received only nine of the 625 (1.4 percent) bachelor's degrees in engineering in the state of Oregon and only 72 of the 1,362 degrees (5.3 percent) in Washington. This circumstance could hardly be considered a threat to job opportunities for nonminorities. Nevertheless, broader access

[1] This monograph is based on the keynote address delivered at NACME's FORUM '97, October 2, 1997.

Figure 1.
U.S. Population Distribution vs. Engineering Workforce

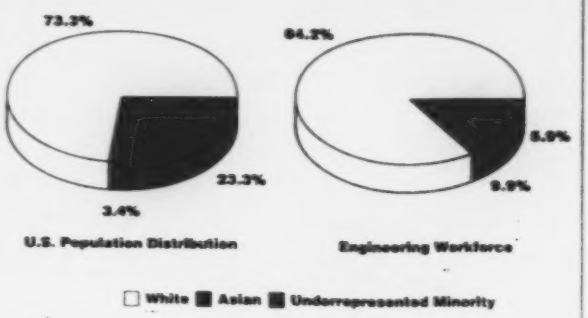
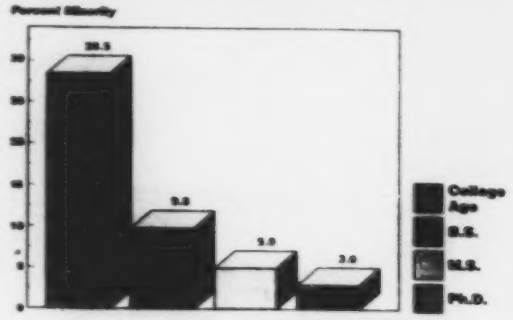


Figure 2.
Minority Engineering Graduates
National, 1996



is under an aggressive, coordinated attack in the region. The state of Oregon recently completed an agreement with the U.S. Department of Education that resulted from a 1990 challenge to its affirmative action financial aid program. Washington state is struggling with the so-called Washington Civil Rights Initiative. Akin to Proposition 209 that was recently passed in California, this voter resolution would prohibit ethnic considerations in university outreach, college admissions, contracting and hiring practices. In addition, the Center for Individual Rights, which brought the highly publicized anti-affirmative action suit against the University of Texas on behalf of Cheryl Hopwood, has filed a similar suit against the University of Washington. This suit, part of a comprehensive national thrust coordinated by organizations opposed to affirmative action, could very well be the next major test of higher education affirmative action policy to reach the United States Supreme Court.[2]

African Americans, Latinos and American Indians constitute 28.5 percent of the college-age population, but less than six percent of the engineering workforce and, in 1996, comprised fewer than ten percent of the bachelors degree graduates in engineering and three percent of the doctorates.

The theme of FORUM '97 was *Crisis and Commitment: Engineering Strikes Back*. The word "crisis" was not chosen lightly. Our intention was not to be alarmist, but to reflect a growing reality that reaches well beyond the northwest region. The nation is drifting towards a canonical third world social order, splintered by insurmountable economic class differences; compounded by ethnic isolation within those classes, amplified by limited access to upward mobility through higher education. The backlash against affirmative action, rapidly gaining momentum across the country, is successfully shutting down further progress for America's fastest growing population groups, already notably absent from critical, high-growth, Information Age jobs. While the seeds have been sown for a national crisis, we can still influence the harvest, if we recognize the urgency and respond effectively.

Whatever political perspective prevails in the current debate on affirmative action, it's important to understand the sheer enormity of the underrepresentation problem in engineering and the dire consequences it portends.

[2] Unfortunately, the New Jersey case, Piscataway Township vs. Taxman, which makes a barely supportable case for affirmative action, is already on the Supreme Court's docket. This case could conceivably yield a broad decision covering other uses of affirmative action, including university admissions, thereby preempting further tests.

While we've made enormous progress creating access over the past quarter of a century, African Americans, Latinos and American Indians collectively comprise almost a quarter of the American population, but less than six percent of the engineering workforce (Figure 1). The three population groups already make up 28.5 percent of the college-age population, but in 1996 produced fewer than ten percent of the bachelor's degree graduates in engineering, five percent of the master's degrees and a dismal three percent of the doctorates (Figure 2).

Engineers are at the heart of wealth creation and economic development in all modern societies. If we consider elementary and secondary school teaching separate fields, engineering is the largest profession in America. The persistent, conspicuous underrepresentation of groups that account for 33 percent of the birth rate jeopardizes the nation's future competitiveness and, consequently, the standard of living, not only for minorities, but for all Americans.

One of the unique attributes of engineering is that one can often enter the world of research and development as a full professional with only a bachelor's degree or, almost certainly, with a master's degree. This is not the case for other scientific disciplines, such as physics, chemistry or biology, where a doctorate is virtually an absolute requirement. Nevertheless, our lack of success in producing a reasonable number of minority doctorates in engineering will have a profound impact on future access to the profession. It means that for years to come the academic community will be denied a wealth of talent, that academic institutions will remain deprived both technically and pedagogically, that minority students going through college will continue to see engineering as an exclusive domain of other ethnic groups. In the words of Seattle Mayor, Norman Rice, minority students will not be able to see themselves in the faces of their professors.

Minority women, fifteen percent of the college-age population, make up only 1.1 percent of the engineering workforce and, in 1996, received only 2.7 percent of the bachelor's degrees and 0.7 percent of the doctorates in engineering.

It's instructive to compare engineering with the other SEM (science, engineering and mathematics) disciplines. In absolute terms, progress in engineering has been at the forefront. The number of minority degrees has grown faster than for all other fields (Figure 3). However, this has to be understood in context. By far the largest of the SEM professions, engineering has posted the highest growth in numbers, but still produces fewer minority degrees in *proportion* to the total, compared to all major SEM fields except the physical sciences (Figure 4). Separating

Figure 3.
Minority BS Degrees
SEM, 1979-1994

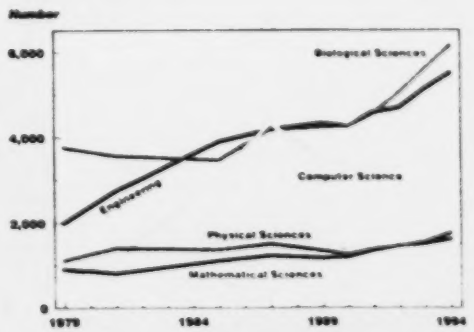


Figure 4.
Minority SEM Graduates
B.S., 1994

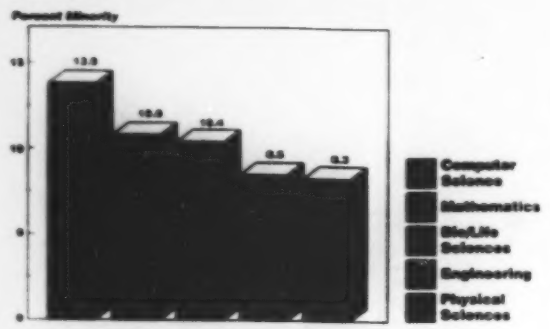


Figure 5.
Minority Women Graduates
Engineering, 1996

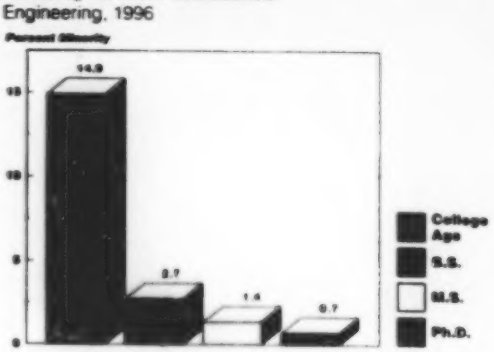


Figure 6
Women SEM Graduates, BS

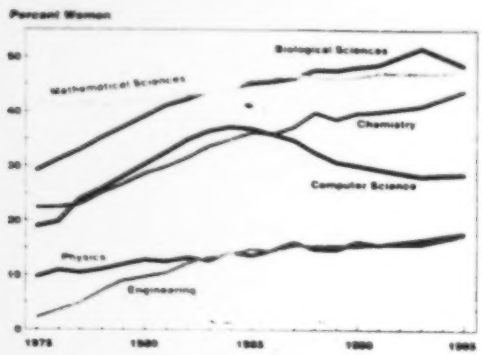
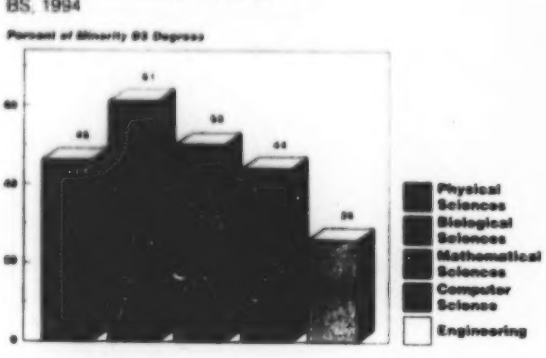


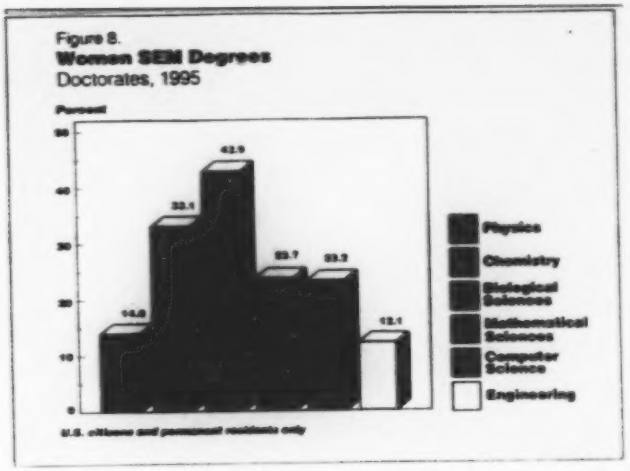
Figure 7
Minority Women SEM Degrees
BS, 1994

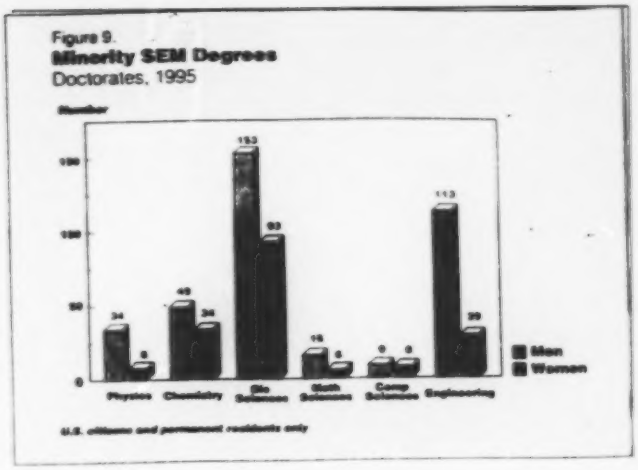


out physics and chemistry from the physical sciences, only physics yields a lower percentage of minorities than engineering.

Dividing the population into more and more granular categories for purposes of social science research and policy analysis becomes counterproductive at some point. However, minority women, at fifteen percent of the college-age population and impeded by the double bind of ethnic and gender biases, constitute an important group to consider separately. They make up only 1.1 percent of the engineering workforce and, in 1996, received only 2.7 percent of the bachelor's degrees and 0.7 percent of the doctorates in engineering (Figure 5).

Women of all ethnicities have made the least progress in physics and engineering compared to other SEM fields, suggesting that the particular social construction of these disciplines continues to inhibit women's participation (Figure 6). In most other fields, at the bachelor's degree level, women are actually approaching parity with respect to men. Though minorities of both genders are significantly underrepresented, minority women in all disciplines except physics and engineering are separately approaching and, in some cases, exceeding parity compared to men of the same ethnicity (see Figure 7; however, note that this chart does not separate out physics from the physical sciences). For example, in 1994 African





American women received more bachelor's degrees in computer science, the biological sciences and the mathematical sciences than African American men. This should not be construed as great progress for minority women, since it's largely attributable to the dearth of minority men. It's also important to note that there is a disproportionate fall-off of women in the SEM fields at the advanced degree level (Figure 8). The number of minority women earning doctorates, in particular, is minuscule (Figure 9).

Declining Enrollment in Engineering

The most immediate concern for us at NACME and one of the defining elements of the crisis we face is that engineering enrollment continues to decline, and the rate of decline for minorities has begun to exceed that for nonminorities (Figure 10). Relative to the peak in 1992, there were 1,576 fewer minority freshmen in the fall of 1996, a 10.4 percent drop. Given that there were just over 6,000 minority graduates in 1996, a decline in freshman enrollment of almost 1,600 is far from inconsequential, even though the eventual impact on graduation numbers will be somewhat attenuated by the retention factor. That is, 1,600 fewer freshmen will translate to about 600 fewer graduates four or five years later. Nonminority freshman enrollment also dropped significantly (8.9 percent) during the same time period, continuing a trend that began in the early 1980s. This trend yielded a drop in total engineering degrees awarded to nonminorities, from a peak of more than 73,000 in the mid-1980s to fewer than 60,000 in recent years. What's even more significant is that the proportion of bachelor's degrees that goes to engineering majors declined among all American students. In the mid-1980s more than eight percent of the B.S. degrees in the United States were in engineering. Currently, engineers make up just over five percent of the graduates. For minority students the proportion of bachelor's degrees that are in engineering dropped from a peak of 4.7 percent in 1989 to 3.6 percent in 1995 (Figure 11).

The declines in engineering enrollment are not associated with changes in college participation rates, smaller numbers of qualified high school graduates, decreases in the numbers of 18 year-olds or any other demographics shifts. They reflect instead a fundamental change in values, interests and choices among students.

The declines in enrollment, then, are not associated with changes in college participation rates, smaller numbers of qualified high school gradu-

Figure 10.
Decline in Engineering Enrollment
Freshman Enrollment, 1992 vs. 1996

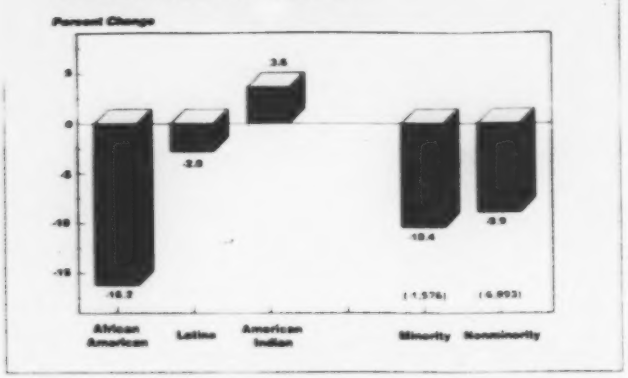
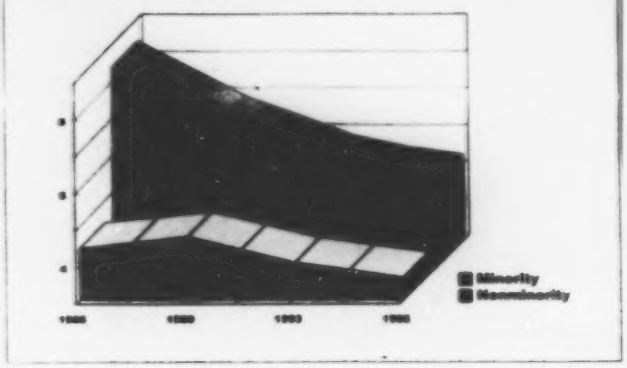
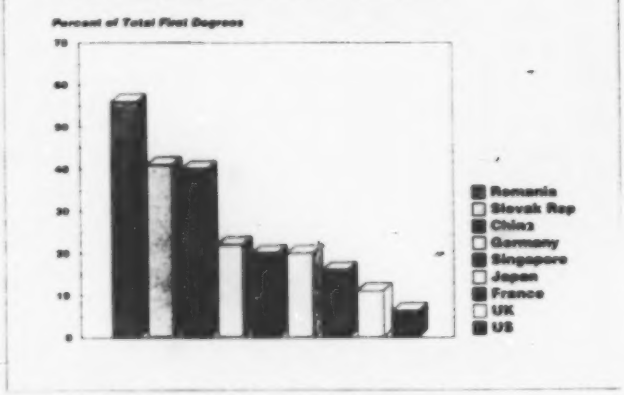


Figure 11.
Engineering Degrees
Percent of Total B.S. Degrees



Relative to the peak in 1992, there were 1,576 fewer minority freshmen in the fall of 1996, a 10.4 percent drop. Nonminority freshman enrollment also dropped significantly (8.9 percent) during the same time period, continuing a trend that began in the early 1980s.

Figure 12
First University Degrees in Engineering



ates, decreases in the numbers of 18 year-olds or any other demographic shifts. They reflect instead a fundamental change in values, interests and choices among students, a change which has enormous implications for our future economic competitiveness. The United States in the past has enjoyed a strong lead over our competitor nations with respect to the percent of engineers in the labor force. However, our current rate of producing engineers is among the lowest of the industrialized and newly industrialized nations, which places our tenuous lead in jeopardy (Figure 12).

Growing Demand for Engineers

While the talent pool of African Americans, Latinos and American Indians continues to be underutilized in engineering and while enrollment declines precipitously among all ethnic groups, the demand for engineers and other technically trained people is growing explosively. During the past four years, actual engineering employment increased from 1,717,000 to 2,051,000, a growth of almost 20 percent. The current unemployment rate for engineers stands at a near-record low of 1.5 percent, less than a third of the unemployment rate for the work force as a whole (4.9 percent). According to a recent survey by the Information Technology Association of America, there are at this moment almost 200,000 unfilled jobs in computer and information technology. The average starting salary for 1997 engineering graduates

with just a bachelor's degree approached $40,000, which was 40 percent higher than that for business administration graduates, 75 percent higher than that for liberal arts graduates, and rivaled the starting salaries for 1997 law school graduates (Figure 13).

To meet our workforce needs, the United States has come to rely heavily on foreign-born engineers (Figure 14). In 1995, more than 65,000 of them immigrated to this country. That's as many engineers as American universities produced that year. Foreign-born engineers comprised more than 40 percent of the graduate school enrollment, received almost half of the doctorates awarded and held more than 60 percent of the post-doctoral R&D positions in 1995. Forty percent of the doctoral engineers resident in the United States are foreign born, as are 30 percent of the engineering faculty at American universities.

The last thing I want to do is to promote xenophobia or immigration curbs; however, it's essential for us to understand the dynamics of our technical workforce. In the oil crisis of 1973, we saw what can happen when we depend too heavily on foreign sources for critical commodities, and, in today's world, human capital is our most valuable resource. Recent changes in the increasingly global labor market suggest that the United States is, in many ways, becoming more vulnerable and less favorably positioned to attract well-trained engineering talent. Competitor nations are expanding their investments in research and development relative to GNP, as we contract ours. State-of-the-art R&D laboratories that rival the best American labs are being constructed at universities, government and industrial facilities overseas, attracting graduates who, in the past, would have been more inclined to remain here after their education. Some foreign governments are establishing financial incentives for top expatriate scientists and engineers to return to their homeland. Clearly, the continuing over-reliance on foreign engineers, while neglecting the development of intellectual talent from segments of our own population, is very risky. It's also unnecessary.

Shifting labor costs on an international scale for SEM professionals presents a great opportunity for our scientific enterprise, but crystallizes another emerging risk. Once topping the charts in labor

While engineering enrollments continue to decline, demand for engineers is growing explosively. During the past four years, actual engineering employment increased from 1,717,000 to 2,051,000, a growth of almost 20 percent.

Figure 13.
Starting Salary Offers, BS
1997

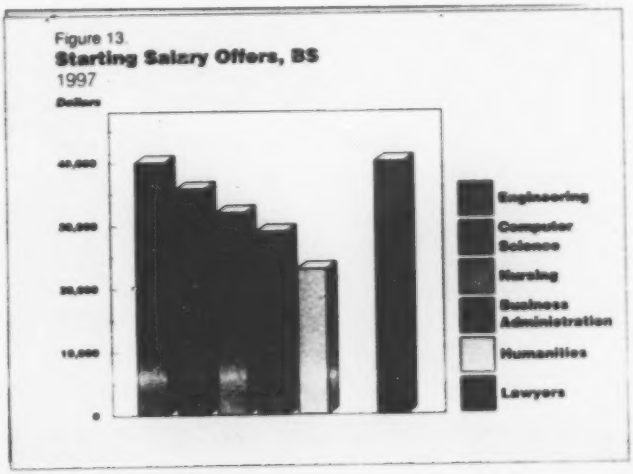
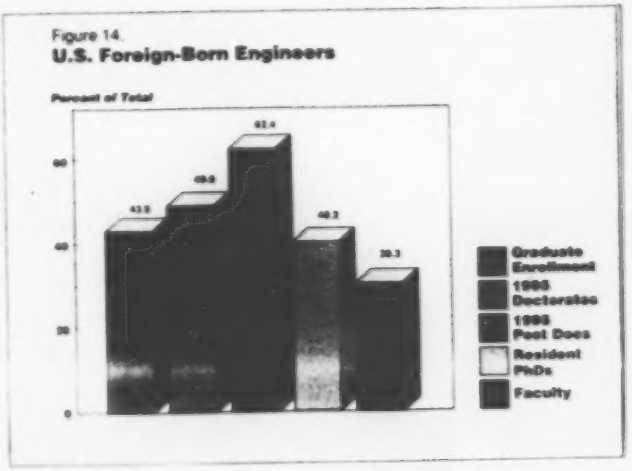
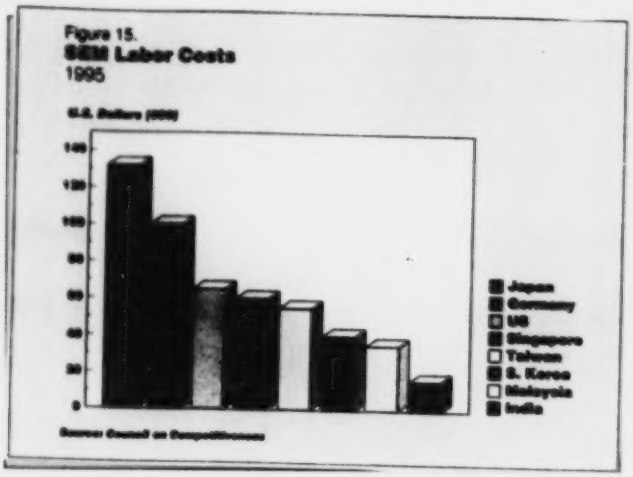


Figure 14.
U.S. Foreign-Born Engineers





costs for scientists and engineers, the United States is now positioned very competitively (Figure 15). This should reduce one of the incentives that led American companies to export an increasing number of R&D jobs in recent years. On the other hand, if we do not produce the necessary work force to meet the growing demand, American companies will be forced, not only to export more R&D jobs, but often to pay higher labor costs while doing it.

To meet our workforce needs, the United States has come to rely heavily on immigrant engineers. In 1995, foreign-born engineers comprised more than 40 percent of the graduate school enrollment, received almost half of the doctorates awarded and held more than 60 percent of the post-doctoral R&D positions. Among engineering faculty, 30 percent are immigrants.

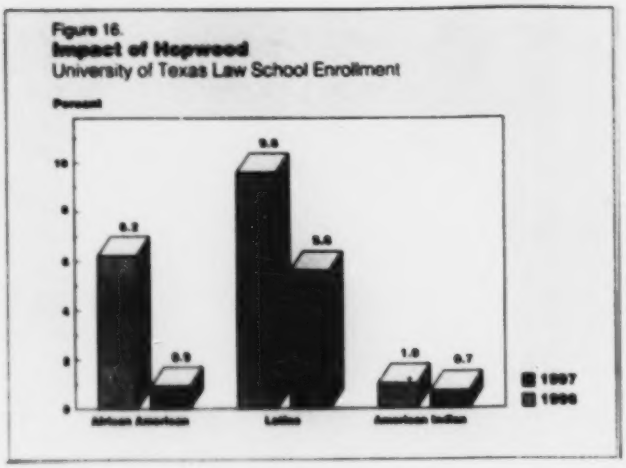
Assault on Affirmative Action

While our failure to develop the talent pool of minorities for the engineering profession threatens America's economic well-being and corrupts our moral fabric, the well-organized, well-funded, politically connected, effectively articulated, anti-affirmative action movement is sweeping the nation. The factional rhetoric, reflected in much of the press coverage, incorrectly equates affirmative action with preferential treatment on the basis of race, an egregious misrepresentation of the concept and original intent of affirmative action policy. Anti-affirmative action resolutions call for an end to racial preferences, when, in fact, federal regulations have always prohibited such preferences. Affirmative action does acknowledge, however, that we are a society that is not yet color-blind, a society with a history of deeply rooted exclusionary practices, a society that demands proactive policies to ensure equal opportunity and to eliminate both conscious and inadvertent discrimination. In making admissions or hiring decisions, both subjective and objective metrics that have inherent biases are commonly used. Without explicitly recognizing those biases in interpreting the metrics, equal opportunity and social justice will be a long time coming.

Opponents attack the concept of affirmative action with several provocative, rhetorical questions: "Aren't there legitimate predispositions of certain groups with respect to career interests? Should every profession, every career path, every job category precisely reflect the population distribution? If so, then shouldn't we have legal intervention and developmental programs to produce more qualified white male basketball players, since they are substantially underrepresented in the National Basketball Association?" My answer to such questions is a resounding yes — *if there is evidence of discrimination, if we uncover a legacy of exclusion.* If the owners, administrative leaders or deci-

sion-makers in the NBA, overwhelmingly white males, have created artificial barriers to entry for white males, then there should, indeed, be such efforts.

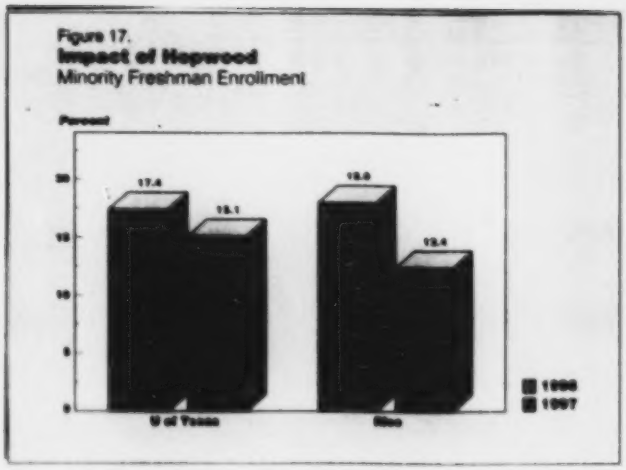
One outcome of the anti-affirmative action activity is the 1996 decision in *Texas v. Hopwood* by the United States Fifth Circuit Court of Appeals, which has jurisdiction over Texas, Louisiana and Mississippi. The court ruling prohibits the use of race or national origin as a factor in public university admissions. This case was not merely about the personal harm Cheryl Hopwood suffered as a result of her rejection from the University of Texas Law School in favor of minority students with lower test scores. Many more nonminority students than minority students with lower test scores than Ms. Hopwood's were admitted to the law school. This case was part of a measured, coordinated national effort on the part of opponents of affirmative action to attack the policy. The Center for Individual Rights which represented Ms. Hopwood recently filed similar suits against the University of Washington on behalf of Katuria Smith who was denied admission to the university's law school in 1994 and against the University of Michigan on behalf of Jennifer Gratz and Patrick Hamacher. The latter significantly raises the stakes.

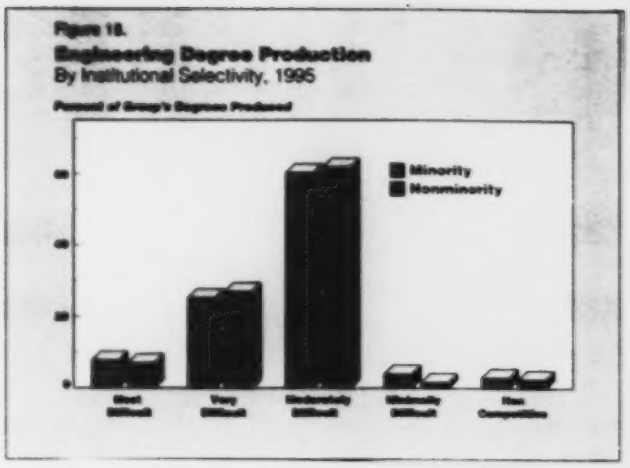


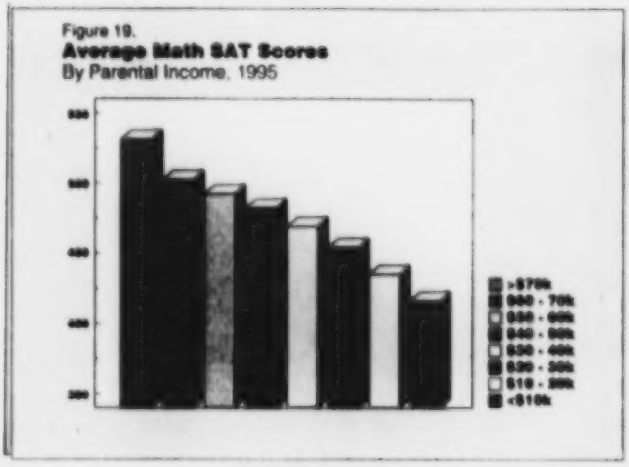
It challenges undergraduate admissions policy for the first time and also, in seeking monetary damages from the president and former president of the university, it introduces the threat of personal liability, thereby increasing the pressure on individual college administrators to back away from affirmative action.

The impact of the Hopwood decision is evident from the significant decline in first year enrollment of minorities in the law school from 1996 to 1997 (Figure 16). African American enrollment dropped from 31 to 4, Latinos from 48 to 26 and American Indians from 5 to 3. The representation of minorities in 1996, with a first year class size of 502, was already unreasonably low considering that minorities comprise 44 percent of the college-age population in Texas. Examining 1997 freshman enrollment, press reports suggest that the impact of Hopwood was mixed or inconclusive. I have a different interpretation of the data. Minority freshman enrollment at the University of Texas declined from 17.4 percent to 15.1 percent, a thirteen percent drop in the proportion of minorities, at a public institution, supported by tax dollars, in a state where everyone pays taxes at the same rate (Texas has no graduated income tax). At Rice University, one of the highly selective private schools in Texas, the proportion of minorities in the freshman class dropped a third, from 18 percent to 12 percent. In a state where minorities will soon constitute a majority, these are, at best, foreboding trends (Figure 17).

The anti-affirmative action movement is well-organized, well-funded, politically connected and effectively articulated, and it's sweeping the nation.







We are a society that is not yet color-blind, a society with a history of deeply rooted exclusionary practices, a society that demands proactive policies to ensure equal opportunity and to eliminate both conscious and inadvertent discrimination.

In California, another state that will soon have a "majority minority" population, affirmative action policies have also been successfully contested. The California Board of Regents passed a resolution banning affirmative action in university hiring and admissions in 1995 and, in 1996, California voters passed Proposition 209. A voter initiative to eliminate affirmative action, the proposal was recently upheld by the courts. The impact on university enrollments has been similar to that in Texas.

Some have conjectured that students who might have attended colleges in Texas or California may be enrolling in other states. However, for public universities, the cost disadvantage of going out of state is a major inhibitor. Moreover, as more and more states reject affirmative action policy, this option will fade altogether. Another speculation is that, although the proportion of minority students declined at the prestigious institutions, other institutions within the affected states may be increasing enrollment. Even if this turns out to be true, we must ask ourselves whether or not that is a desirable outcome for our society. Currently, minority engineering graduates are distributed among the universities categorized by selectivity in roughly the same proportions as nonminorities. That is, the most selective colleges produce about 10 percent of the minority engineering graduates and 10 percent of the nonminority graduates. The next tier produces about 25 percent of both minority and nonminority graduates, etc. (Figure 18). Although students at the undergraduate level can arguably acquire a quality education at a second tier school that will not differ substantially from that at a top tier school, career paths on average are at least loosely correlated with where individuals attend undergraduate school.

Perhaps the greatest danger resulting from the Hopwood decision is that it drives us further and further toward the

imprudent practice of relying on rigid numerical results of standardized tests in determining the qualifications of students for admission to the university. We already know that, for minority students, standardized tests do not yield a good measure of academic capabilities. The Scholastic Assessment Test (SAT), for example, is more reflective of students' parental income than of their academic potential and more highly correlated with parental education than students' eventual success. It's no surprise, then, that minority students do not do as well on SATs as their peers (Figures 19-21). Even when economic and family backgrounds are taken into account, average scores vary by racial or ethnic group. The significance and relevance of the test outcomes also vary by race and ethnicity. While the correlation between test scores and eventual academic performance is low for all groups, it's virtually nonexistent for minority students.

Raw test scores, without taking family background into account, measure past opportunity rather than future academic potential, and are clearly biased along ethnic lines. Given that they're not predictive of academic success, and that the asserted goal of the university admissions process is to select students most likely to succeed, the tests are not even functional. These facts are widely known; however, beyond the legal environment, other factors compel universities to cling to the use of SATs and to seek students with high scores. The average student SAT score, for example, is a key parameter used in university rankings.

If opponents succeed in erasing affirmative action policies, we will have no choice but to oppose the use of standardized tests altogether in favor of more authentic assessments. And there do exist measurable attributes which are much more highly correlated with academic and career success: motivation, determination, interest, commitment to the conceptual framework of engineering, discipline, reliability, creativity, problem-solving skills, willingness to take judicious risks. At NACME, we have a great deal of experience and considerable success using such criteria in the selection process for students in our programs. We have students who started with SAT scores as much as 600 points below the average of their peers but who are graduating

Perhaps the greatest danger resulting from the Hopwood decision is that it imprudently drives us further and further toward standardized test results to determine student qualifications for admission to the university.

Figure 20.
Average Math SAT Scores
By Parental Education, 1995

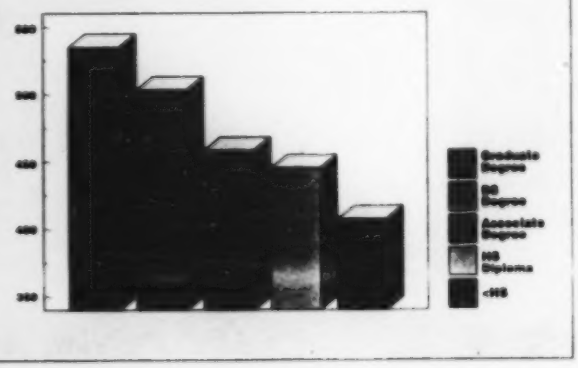


Figure 21.
Average Math SAT Scores
By Ethnicity, 1995

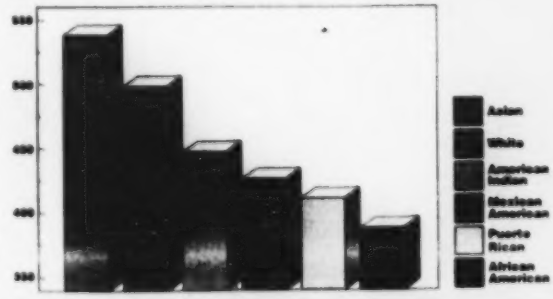


Figure 22.
Engineering Graduates
Top Ten States, 1995

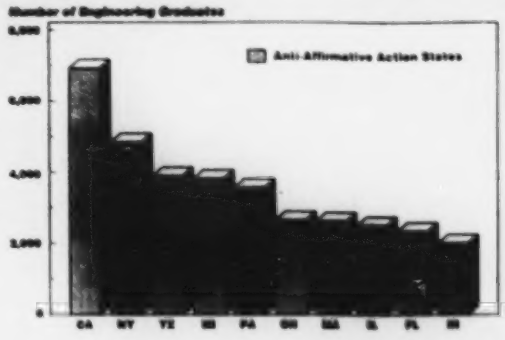
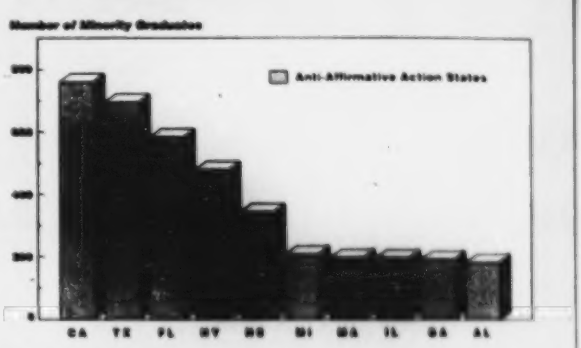


Figure 23.
Minority Engineering Graduates
Top Ten States, 1995



The Scholastic Assessment Test (SAT) is more reflective of students' parental income than of their academic potential and more highly correlated with parental education than with students' eventual success.

with honors from the most prestigious engineering colleges in the country.

It's encouraging that, in both Texas and California, universities are diligently working within the new legal framework to find solutions that will allow them to maintain their goal of building a diverse student body and their commitment to the rich intellectual environment it produces. A University of California task force has recommended that the university system eliminate the use of SAT scores from admissions considerations. In Texas, the legislature voted to require state universities to admit all applying students who graduate in the top ten percent of their high school class regardless of SAT scores.

At least 15 states have substantial anti-affirmative action activities underway, including litigation, voter initiatives, pending legislation or executive actions (Table 1). The list is not intended to be all-encompassing, since anti-affirmative action activity has surfaced in many other places to varying degrees. For example, at the University of Minnesota, the new financial aid director unilaterally ended the school's financial aid affirmative action program. A Kentucky senator wrote a provocative letter to several white students suggesting that minority students received scholarships that they, the white students, should have gotten. To be sure, not all and, in many cases, not even a majority of the residents of the 15 states listed in Table 1 oppose the legitimate use of affirmative action. We have many allies in those states, and, in some cases the bulk of the opposing activity was organized by non-residents. Borrowing from effective strategies of the mid-century Civil Rights Movement, anti-affirmative action political groups have carefully researched specific candidates for court challenges, catalogued individual judges'

Alabama	Montana	Georgia
Michigan	Colorado	Texas
Arizona	Ohio	Louisiana
Mississippi	Florida	Washington
California	Oregon	Maryland

Borrowing, ironically, from effective strategies of the mid-century Civil Rights Movement, anti-affirmative action political groups have carefully researched specific candidates for court challenges, catalogued individual judges' records and scoured the nation to identify optimum legal venues for anti-affirmative action litigation.

records and scoured the nation to identify optimum legal venues for anti-affirmative action litigation.

These states, taken together, have characteristics that make them very important relative to the underrepresentation problem. It's therefore useful, in fact, essential for us to examine the potential impact of their anti-affirmative action initiatives on NACME's work. If we rank all 50 states by the total number of engineering graduates they produce (Figure 22), half of those in the top ten appear in Table 1. Similarly, if we rank the 50 states by the number of minority engineers they produce, half of the top ten on that list also are among the states with intense anti-affirmative action activity (Figure 23). However, the raw numbers don't tell the whole story. States producing the largest number of minority engineers are also states with large minority populations. Eight of the top ten states ranked by percent minority population are among the states in Table 1 (Figure 24).

A more meaningful comparison of states' performance in providing access to engineering requires normalizing the number of graduates to the population distribution. To that end we define the state Engineering Participation Factor (EPF), which is simply the ratio of percent minority graduates to percent minority college-age population in the state. Parity occurs when the proportion of engineering graduates is identical to the proportion of minorities in the college-age population of the state (EPF = 100 percent). Of course, exact parity is not the objective, but when the gaps are as large as they are in a field as important as engineering, our economic health cries out for policies to reduce those gaps. Figure 25 shows the EPF for all 15 states, and Figure 26 shows the top ten states ranked by EPF. Of the anti-affirmative action states, only Florida is more than half way toward achieving parity, though Alabama and Georgia are in the top ten. All three get substantial

Figure 24.
Minority Population
Top Ten States, Percent Minority Population

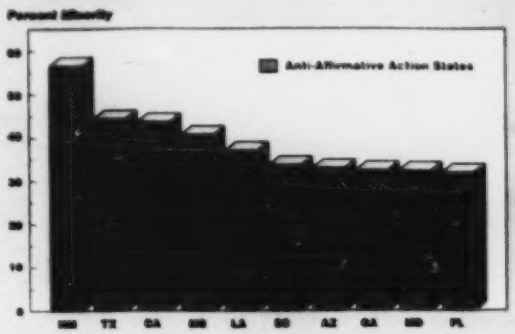


Figure 25.
Engineering Participation Factor
Anti-Affirmative Action States

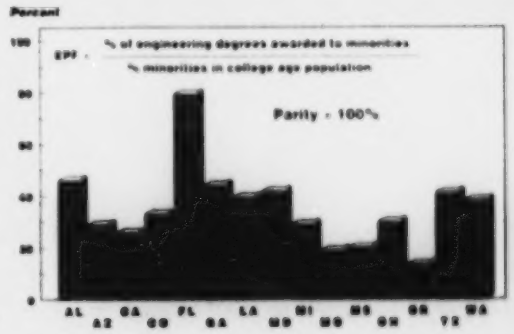


Figure 26.
Engineering Participation Factor
Top Ranked States, 1995

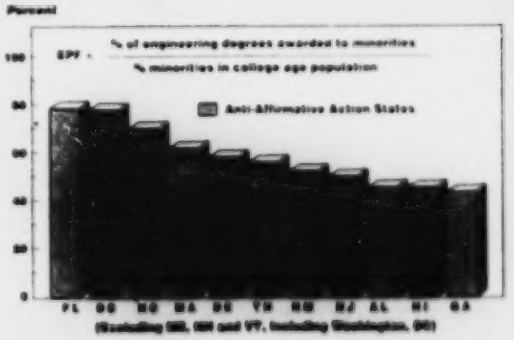
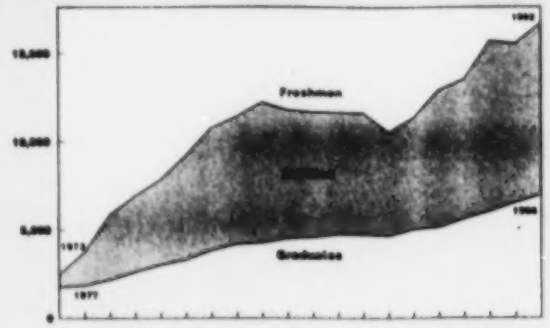


Figure 27.
Minority Retention in Engineering



contributions to the number of minority engineering graduates from the presence of Historically Black Colleges and Universities.

In summary, the 15 states with aggressive anti-affirmative action movements collectively produce a large number of minority engineers. However, the absolute number of graduates is misleading. They also have large minority populations, so that, in most of these states, the underrepresentation problem is more severe than for the average state, and the perceived threat to opportunities of others is hardly equivalent to the threat of discrimination against minorities. That is, anti-affirmative action efforts that can only lead to reduced opportunities for minorities are focused in those regions where there are large concentrations of minorities and where there is already limited access. This means that successful anti-affirmative action outcomes will have a profoundly antithetical, long term impact on national engineering workforce equity.

Retention in Engineering

The inveterate retention problem of minority students in engineering colleges should be an embarrassment to all of us working in higher education. Each year I add a new data point to the retention curve, which plots freshman enrollment versus graduations four years later (Figure 27). The attrition of minorities has hovered at about twice the attrition of nonminorities for almost two decades. Two-thirds of all minority students who enroll in engineering do not get a degree in engineering. We've known about this problem for a long time. We've been working on the problem for a long time. And we seem to be able to solve the problem, but only on a small scale. There are a number of very successful, individual engineering programs. For example, NACME's Corporate Scholars Program has a retention rate greater than 80 percent. Our relatively new Engineering Vanguard Program, which targets inner city youth whose circumstances led them to be underachievers in high school and which has a broader goal of expanding the pipeline for science-based disciplines, has not lost a single student in four years. But all of NACME's undergraduate programs collectively reach only a thousand minority students, and there are more than forty thousand enrolled in engineering colleges. All of the successful programs together have not made a dent at the national level.

Perhaps, what's most frustrating is that those of us in the business believe we know what impediments exist, as well as what the solutions are. At the top of the list of barriers is unmet financial need. Many minority students in engineering college are operating at the edge of financial viability from year to year and are continuously at risk of dropping out. If anything unexpected happens, e.g., if tuition rises substantially or their financial package is decreased — all too frequent occurrences — they're forced to leave. Exacerbating this problem is shifting financial aid policy at universities. In particular, scholarships are increasingly

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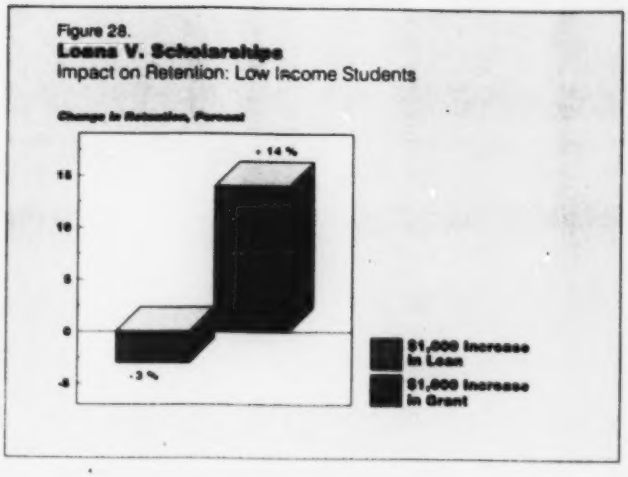
used to recruit more affluent students in order to maximize net tuition revenues. Reinforcing a problem described earlier, some universities widely use SAT scores to determine "merit" for purposes of scholarship allocations. Since scores are highly correlated with family income, this, whether a conscious policy or not, supports the paradoxical university strategy of attracting wealthy students through scholarships. As in retail operations, the effective use of discounting leads ultimately to increased market share and higher revenues. In this case, students from high income families constitute the desired market.

The financial needs of poor students are increasingly met through loans rather than scholarships, and the debt burden for minority students has been growing at more than twice the rate for nonminority students. This has a major impact on retention. A study by the General Accounting Office shows that for students from families in the lowest income quartile a shift of just $1,000 from scholarship aid to a loan reduces their probability of graduating by 17 percent (Figure 28).

Other issues affecting retention include institutional factors, the social construction of the discipline: a white male dominated culture, low expectations and unsupportive attitudes of engineering faculty towards minority students, gender and ethnic isolation in engineering college, the lack of mentors and the absence of peer support. These are not necessarily the result of overt or even conscious efforts to discriminate. They simply reflect our ethnocentric culture and lack of experience, sensitivity and effectiveness in cross-cultural interactions. These are all things that can be substantially eliminated through professional development and training of faculty and students.

Insufficient academic preparation is also a factor in the attrition equation. Unfortunately, virtually all of the retention efforts focus on this issue to the exclusion of all others. Preparation is certainly important. Minority students from inner city schools, for example, are often less well-prepared than their peers from suburban schools or from the specialized mathematics and science magnet schools, which are increasingly popular among students interested in engineering. Though academic support for some students is essential, more resources need to be devoted to the other factors that play an important role in the overall attrition rates. Moreover, a concentration on presumed student deficiencies can be highly counterproductive. It reinforces low expectations, skepticism and negative attitudes towards the students, and neglects the fact that many minority students who leave engineering are doing quite well academically.



For students from families in the lowest income quartile, a shift of just $1,000 from scholarship aid to a loan reduces their probability of graduating by 17 percent.

In spite of endless publications, best practices workshops, conferences and university coalitions focusing on retention, the problem persists. Experience teaches us that, in the field of education, dissemination and replication of effective strategies, successful programs or proven classroom practices, whether at the kindergarten, eighth grade, high school or university level, are very difficult propositions. However, if we're going to make progress, we must find a solution to this intractable, national problem of attrition.

Figure 29.
School Enrollment
Elementary and Secondary, 1994

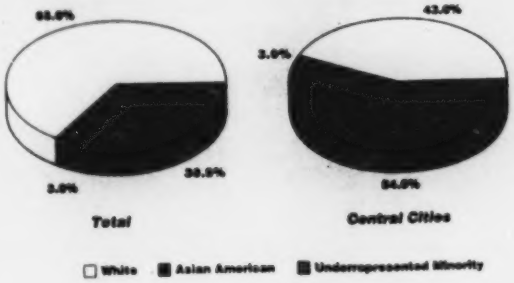
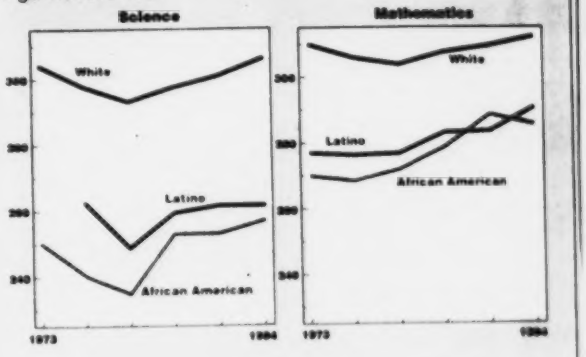
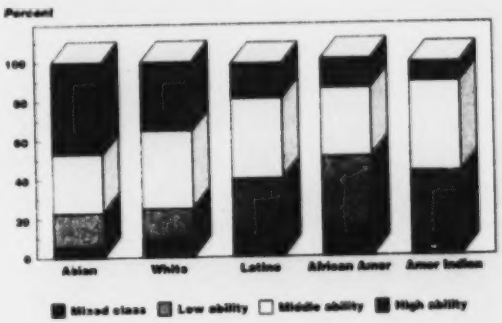


Figure 30.
NAEP Average Proficiency Scores
Age 17, 1973-1994



Among the half million minority high school students who graduate each year, 32,000 have the required prerequisites. Astonishingly, almost half of them major in engineering. Clearly, our greatest hope of increasing the production of minority engineers is to increase the number of qualified high school graduates.

Figure 31.
Tracking By Ethnicity



Precollege Preparation

The linchpin of the crisis we've been describing is that public schools fail to prepare minority students for higher education and particularly for math and science-based majors. The demographics of elementary and secondary schools make this issue extremely compelling. Underrepresented minority children constitute more than 30 percent of total enrollment of all American schools, and 54 percent in Central Cities, as defined by the Census Bureau (Figure 29). Despite billions of dollars invested annually in education reform, based on the National Assessment of Education Progress, very little progress has been achieved for students from all ethnic groups. And though the gaps between minorities and non-minorities in mathematics and science achievement have narrowed slightly, they still loom very large (Figure 30).

At the root of the problem is an enduring belief in widely varying innate and immutable intelligence among children. Belying cognitive research outcomes, the American education establishment remains unwilling to internalize the idea that all children can learn at high levels, that academic achievement is more a function of effective effort than genetics. The pervasiveness of tracking systems continues to disproportionately assign minority students to lower level classes (Figure 31). Moreover, low expectations of students not in the highest tracks deny

Figure 32.
HS Course Completion

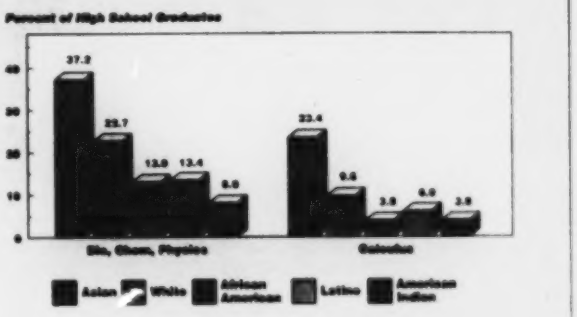
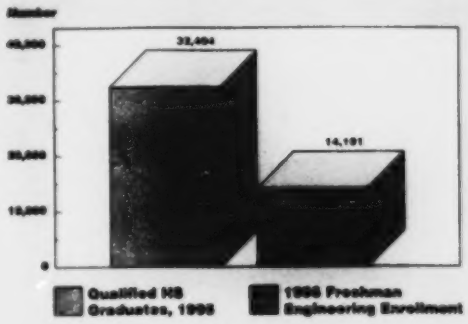


Figure 33.
Minority Engineering Recruitment



No amount of spending, curriculum reform, national testing or learning technology will solve our education problem as long as teachers believe that students can't learn.

opportunity to the vast majority of nonminority students as well. No amount of spending, curriculum reform, national testing or learning technology will solve our education problem as long as teachers believe that students can't learn. A few years ago, a fraction of the population with a high quality mathematics and science education sufficed to meet the workforce needs, but in today's world that will not serve either the workforce or the national interest well. Still, only 15 percent of American students take the academic mathematics and science curriculum required to major in a technical field. For minority students, it's six percent (Figure 32). In contrast, calculus and physics, which are not even available at many American high schools, are required courses in many of our competitor nations.

Many universities have been pouring resources into improving their recruitment of minorities. Those schools that are most successful will, indeed, increase diversity at their institutions, but only at the expense of other colleges. Among the half million minority high school students who graduate each year, 32,000 have the required prerequisites. Astonishingly, almost half of them major in engineering (Figure 33). Since these are among the best prepared students coming out of high school, they can major in anything they want. Therefore, engineering colleges, collectively, are already enormously successful on the recruiting end, and our greatest hope of increasing the production of minority engineers is to increase the number of qualified high school graduates.

Need for Action

We cannot successfully continue down the path we're headed as a nation: bifurcated into haves and have-nots, stratified by ethnicity, with limited access to upward mobility through higher education (Figures 34 and 35). We cannot afford the huge gaps in access to engineering careers, traditionally the most effective path to upward mobility, with 28.5 percent of the

We must not lose sight of the momentum we've achieved and the progress we've made over the past quarter century — from producing just a few hundred minority graduates per year at the end of the Civil Rights era, we're now producing more than 6,000.

Figure 34.
Income Distribution
Poverty Levels

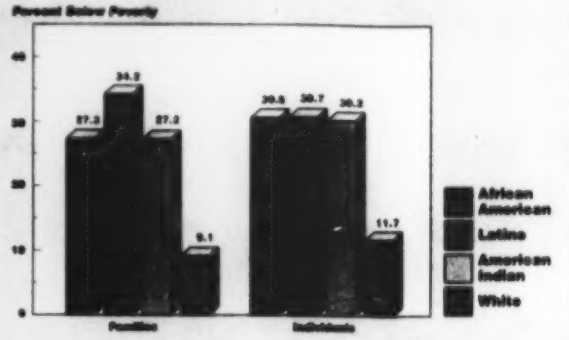
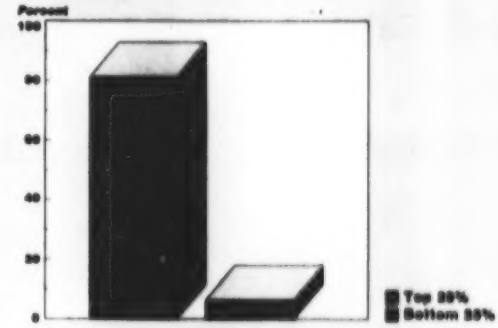


Figure 35.
Probability of B.S. by Age 24
By Income Level



While we demand more from our schools — high expectations, access to high quality mathematics and science programs and authentic assessments — we must, at the same time, demand more from our children.

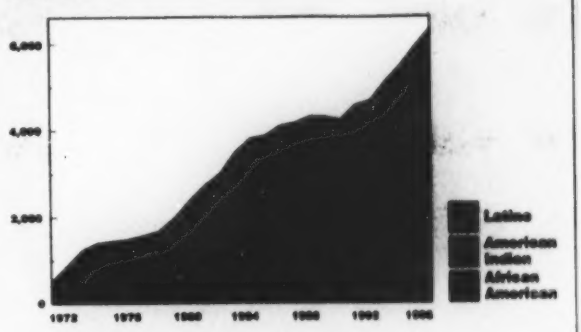
college-age population generating fewer than ten percent of the bachelor's degrees and three percent of the doctorates.

Though these outcomes by themselves can be discouraging, we shouldn't lose sight of the fact that our gains have been impressive. We must not lose sight of the momentum we've achieved and the progress we've made over the past quarter century — from producing just a few hundred minority graduates per year at the end of the Civil Rights era, we're now producing more than 6,000 (Figure 36), from a handful of doctorates annually, we now award a couple of hundred. But, these gains are quite tenuous and the infrastructure that supports them is very fragile. Given that few research and development operations and few universities have a critical mass of minority engineers, eliminating policies that create equitable opportunity and inclusion can wipe them out overnight. This vulnerability is what makes the risks associated with the effectively orchestrated anti-affirmative action movement so alarming.

Those of us in leadership positions have a responsibility to take back the ownership of civil rights policy and its legitimate goals — neither preferential treatment, nor pretense of color-blindness, but genuine equal opportunity through proactive, affirmative, action. We must reaffirm our commitment to equity. We must organize, concentrate and focus our efforts. We must forge a coherent, collaborative strategy. We must reassert our presence on the public policy landscape. We must raise our voices to a level that can compete with the increasingly strident voices of opposition, that can compete not only in volume, but also in content, knowledge and information. Today, the American people are hearing loudly and clearly only one side of the story. I'm convinced that, once we articulate the other side, once we present our case with the same degree of intensity, coherence and effectiveness, once the American people understand the real consequences of backsliding on matters of social justice — the impact on our standard of living, the degradation of our political stability, and, ultimately, the threat to our freedom — they will collectively make the correct policy decisions and the right ethical and moral choices.

We also have a responsibility to lead our own communities. While we demand more from

Figure 36.
Minority Engineering Graduates
National



our schools — high expectations, access to high quality mathematics and science programs and authentic assessments — we must, at the same time, demand more from our children. We must have high expectations of them and hold them to exemplary standards. Whatever happens in the policy arena, we must continue to make intellectual development, academic achievement, the importance of mathematics and science and the relentless pursuit of academic excellence number one on our agenda and central to our most deeply held cultural values. ■

Today, the American people are hearing clearly only one side of the story. I'm convinced that, once we articulate the other side, once we present our case with the same degree of intensity, coherence and effectiveness, they will collectively make the correct policy decisions and the right ethical and moral choices.

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About the Author

George Campbell Jr. is president and CEO of NACME, Inc., a non-profit corporation that conducts research and public policy analysis, develops and operates precollege and university enrichment programs, publishes original educational materials and is America's largest privately funded source of scholarships for engineering students from underrepresented groups.

Dr. Campbell earned his Ph.D. in theoretical physics from Syracuse University and a B.S. in physics from Drexel University. He is also a graduate of the Executive Management Program at Yale University. Dr. Campbell is a recipient of the George Arents Pioneer Medal in Physics, winner of the Drexel University Centennial and Presidential Medals, a Fellow of the American Association for the Advancement of Science (AAAS) and a member of the President's Circle: National Academy of Sciences, National Academy of Engineering and Institute of Medicine.

Dr. Campbell has conducted research in theoretical high energy physics and in magnetospheric physics. During twelve years at AT&T Bell Laboratories, he held various R&D and management positions, and, in 1987, became a member of Bell Labs' Leadership Continuity group. In the 1970s, he was part of the team that developed the third generation of communications satellites, and from 1985 through 1988, he led a Bell Labs team in an unprecedented international research and development collaboration with Kokusai Denshin Denwa of Japan and British Telecom International. For seven years, he served as a United States delegate to the International Telecommunications Union. Earlier in his career, Dr. Campbell spent two years on the faculty of Nkumbi International College in Zambia. He has published papers in mathematical physics, high energy physics, satellite systems, digital communications and science and technology policy.

Dr. Campbell has served on the United States Secretary of Energy Advisory Board, the AAAS Committee on Science, Engineering and Public Policy, the National Research Council's Committee on Women in Science and Engineering, and as chair of the New York City Chancellor's Task Force on Science Education. He is currently a member of the Board of Trustees of Rensselaer Polytechnic Institute, the New York Hall of Science and Polytechnic University, the Engineering Advisory Council of Cooper Union, the Advisory Board of the Merck Institute for Science Education, and the Board of Directors of the Oak Ridge Associated Universities. Dr. Campbell is a regular commentator on PBS-TV's *Nightly Business Report*.

Married for 29 years to Dr. Mary Schmidt Campbell, dean of New York University's Tisch School of the Arts, he and his wife have three sons and live in Harlem.

NACME in Brief

NACME is a not-for-profit corporation that, for more than 20 years, has led the national effort to increase access to engineering and other science-based careers. Supported by America's leading technology-intensive companies, NACME conducts research and public policy analysis, develops and operates national demonstration programs at precollege and university levels, and disseminates information through publications, conferences and electronic media. NACME is also the nation's largest privately funded source of scholarships for minority students in engineering.

In 1996, President Clinton awarded NACME the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring.

Long-term Achievements

- Since 1980, 10 percent of all minority graduates in engineering—more than 6,600 African Americans, Latinos and American Indians—have gone through college with NACME scholarships.
- Over a million students, teachers and faculty members, nationwide, have benefitted from NACME precollege and university education programs and training.
- NACME research and briefings are regularly provided to the leaders of the science and technology policy community.
- Annual minority graduations have increased from 1,423 in 1974, the year that NACME was established, to an all-time high of 6,331 in 1996.

Program Highlights

- NACME's Corporate Scholars Program (CSP) offers students professional development, academic support, mentoring and valuable R&D experience through summer internships. The result: a remarkable retention rate of 83 percent, and an average GPA of 3.28.
- The Engineering Vanguard Program is an innovative scholarship effort that provides intense academic and leadership training to culturally diverse teams of high school students from economically disadvantaged communities. Together, each group attends a top engineering institution that has worked with NACME to build an enhanced academic infrastructure and offer full financial support.
- NACME's *Math Is Power* is a public service advertising campaign that tells children and their parents, nationwide, that they must demand academic track math and science in high school to keep their career options open. Since its release in June of 1995, *Math Is Power* has leveraged over $49.6 million in donated space and time on TV, radio, bus shelters and mall boards, in newspapers and magazines and on the Internet.
- The NACME Diversity Seminars, based on models long employed by the corporate sector, allow faculty and students to examine deeply held attitudes about race, class and gender and facilitate cross-cultural communication on the university campus.

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